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National Security and
International Affairs Division

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The Honorable Fred Thompson
Chairman, Committee on Governmental Affairs
United States Senate

The Honorable Joseph I. Lieberman
Ranking Member, Committee on Governmental Affairs
United States Senate

Subject: Observations on the National Aeronautics and Space Administration's
Fiscal Year 1999 Performance Report and Fiscal Year 2001 Performance Plan

As you requested, we have reviewed the 24 Chief Financial Officers (CFO) Act agencies' fiscal year 1999 performance reports and fiscal year 2001 performance plans required by the Government Performance and Results Act of 1993 (GPRA). In essence, under GPRA annual performance plans are to establish performance goals and measures covering a given fiscal year and provide the direct linkage between an agency's longer-term goals and day-to-day activities. Annual performance reports are to subsequently report on the degree to which those performance goals were met. This letter contains two enclosures responding to your request concerning key program outcomes and major management challenges at the National Aeronautics and Space Administration (NASA). Enclosure I to this letter provides our observations on NASA's fiscal year 1999 actual and fiscal year 2001 planned performance for the key outcomes that you identified as important mission areas for the agency. These key outcomes are (1) expand scientific knowledge of the Earth system, (2) deploy and operate the International Space Station safely and cost-effectively, and (3) expand the commercial development of space. Enclosure II lists the major management challenges facing the agency that we and NASA's Inspector General identified, how their fiscal year 1999 performance report discusses the progress the agency made in resolving these challenges, and the applicable goals and measures in the fiscal year 2001 performance plan.

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Results in Brief

NASA made progress in meeting its fiscal year 1999 performance targets for the three key agency outcomes included in our assessment.¹ Reported fiscal year 1999 performance objectives and targets were generally objective and measurable. However, we also identified several weaknesses. For example, in its fiscal year 1999 performance report, NASA indicates that it, along with other federal agencies that are engaged in science and technology, has difficulty in quantifying outcomes and relating outcomes to spending because of the long-term character of its objectives. The fiscal year 2001 performance plan still relies heavily on output measures. We believe that the continued use of output measures burdens NASA by requiring it to continuously demonstrate the linkages between program efforts and results and to make improvements needed to strengthen such linkages.

NASA also does not provide reasonable assurance in its fiscal year 1999 performance report that the performance information used is credible. Discussion of data credibility is limited to stating that each of the program and project managers are fully accountable for the accuracy of the performance information. Moreover, the fiscal year 2001 performance plan still does not include an explicit discussion of procedures for verifying and validating performance data and does not address possible data limitation issues and problems. In general, the fiscal year 2001 performance plan still does not (1) provide a clear rationale for how information technology-related strategies and programs will contribute to achieving NASA's goals or (2) show any allocation of information technology-related dollars and personnel to performance goals.

Of further concern is NASA's intended use of performance indicators starting with the fiscal year 2001 performance plan. Our specific concern is not related to the indicators themselves but to how NASA plans to use them in assessing whether a performance target has or has not been met. A NASA official indicated that a target could be assessed as having been met even if some of the indicators supporting the target were not achieved. We believe that this approach requires NASA to provide convincing evidence that a desired outcome was met despite the nonachievement of one or more of the supporting indicators. We have the following additional observations on NASA's fiscal year 1999 performance report and fiscal year 2001 performance plan:

- For the three key outcomes we evaluated, the performance report includes all targets established in the fiscal year 1999 performance plan. Although the performance information articulates the degree to which the targets were or were not achieved, some additional explanation is needed. For example, for the key outcome of expanding scientific knowledge of the Earth system, the performance

¹ NASA's fiscal year 1999 performance plan and report identify an objective closely related to one of the key outcomes you identified—deploying and operating the International Space Station safely and cost-effectively. The objective is stated as deploying and operating the space station for research, engineering, and exploration activities. We based our assessment on that objective.

assessments provide a reasonable explanation for all of the targets that were not met except for one; in that case, a clear explanation for why the target was not met was not provided. As a result, the impact of not having data from Global Positioning System receivers to test improved algorithms for measuring the atmosphere's temperature on this key outcome cannot be determined and corrective actions cannot be assessed.

- The fiscal year 1999 performance report includes an independent evaluation completed by the NASA Advisory Council. According to the performance report, the Council provided a qualitative evaluation of NASA's fiscal year 1999 performance, going beyond the question of whether NASA met specific performance targets in the fiscal 1999 performance plan. For example, the Council identified the need to develop a crew return vehicle for the International Space Station—a suggestion that enhances confidence in NASA's ability to meet the key outcome of deploying and operating the space station safely and cost-effectively. We also believe that NASA should establish targets for safety, cost-control, and risk mitigation measures to strengthen this related key outcome.
- NASA's Advisory Council also commented on a key performance target related to the outcome of expanding the commercial development of space. That performance target was to continue the X-33 vehicle assembly in preparation for flight-testing. The Council commented that while assembly of the X-33 vehicle was on track near the end of fiscal year 1999, enormous challenges remained. While NASA met its fiscal year 1999 target of continuing the X-33 vehicle assembly, a hydrogen tank failure in November 1999 exacerbated the challenges this program faces. NASA states that a performance indicator for the X-33 program cannot be included in the fiscal year 2001 performance plan until the hydrogen tank delamination investigation and program impact assessment are complete. We believe that close monitoring of the X-33 vehicle assembly is critical. As a key technology demonstrator that may pave the way for the commercial development of reusable launch vehicles by reducing cost and increasing space transportation reliability, it has a direct relationship with the key outcome of expanding the commercial development of space. Related targets and indicators must be identified to enable such monitoring.
- The cause for unmet targets can often be traced to NASA's indicators in its fiscal year 1999 performance plan. For example, over half of the performance targets related to the key outcome of expanding scientific knowledge of the Earth system were not met because achievement was tied to the fiscal year 1999 launch of the Terra spacecraft and to the successful operation of the third stratospheric aerosol and gas experiment. However, although a significant number of targets were not met in fiscal year 1999, most are recoverable in fiscal year 2000. The Terra spacecraft was launched in December 1999, and NASA anticipates that data collections associated with the fiscal year 1999 targets related to this key outcome will be accomplished in fiscal year 2000.

NASA's fiscal year 1999 performance report and fiscal year 2001 performance plan

describe goals and measures for 8 of NASA's 10 management challenges. However, both the plan and report fail to provide enough specific information on some of these management challenges to fully assess NASA's actions. We have the following additional observations on NASA's treatment of its management challenges in its fiscal year 1999 performance report and fiscal year 2001 performance plan:

- The performance report does not provide enough specific information on four of these management challenges to fully assess the extent to which NASA has addressed them. For example, NASA's performance report provides no specific information regarding NASA's progress in overcoming the previously reported problems with fielding the Earth Observing System Data and Information System (EOSDIS).
- The performance plan also does not provide enough specific information on four of these management challenges to fully assess the extent to which NASA has addressed them. For example, while NASA's performance plan has a target to enhance information technology security, we cannot fully assess NASA's actions because the plan lacks sufficient information.
- NASA did not directly address 2 of the 10 management challenges, namely (1) International Space Station program cost control and (2) closer cooperation between NASA and the Department of Defense and the development of a national perspective on aerospace test facilities.
- NASA made a major change in its approach to the contract management challenge after the reports were issued. Because of difficulties encountered in developing an integrated financial management system—a critical component to enhancing contract management—NASA has delayed agencywide deployment of the system. As a result, targets established for fiscal year 2001 cannot be achieved.

Objectives, Scope, and Methodology

Our objectives concerning selected key agency outcomes were to (1) identify and assess the quality of the performance goals and measures directly related to a key outcome, (2) assess the agency's actual performance in fiscal year 1999 for each outcome, and (3) assess the agency's planned performance for fiscal year 2001 for each outcome. Our objectives concerning major management challenges were to (1) assess how well the agency's fiscal year 1999 performance report discussed the progress it had made in resolving the major management challenges that we and the agency's Inspector General had previously identified and (2) identify whether the agency's fiscal year 2001 performance plan's goals and measures were applicable to the major management challenges. As agreed, to meet the Committee's tight reporting time frames, we generally based our observations on the requirements of GPRA, guidance to agencies from the Office of Management and Budget for developing performance plans and reports (OMB Circular A-11, Part 2), previous reports and evaluations by us and others, our knowledge of NASA's operations and

programs, and our observations on NASA's other GPRA-related efforts. We did not independently verify the information contained in the performance report or plan. We conducted our review from April through May 2000 in accordance with generally accepted government auditing standards.

Agency Comments and Our Evaluation

In written comments to a draft of this report, NASA's Associate Deputy Administrator commented on two issues: (1) the usefulness of the revised approach in the Fiscal Year 2001 Performance Plan for reporting on progress and (2) data validation and verification.

Concerning reporting on progress, NASA expressed concern that we had not taken the opportunity to assess the agency's performance report and plans in the context of the goals and missions it is striving to achieve. NASA stated that it tried to strike a balance between current expenditures and the achievement of longer-term goals and objectives and to put successes and failures in an appropriate context. Because outcomes in research and development are not realized for lengthy periods, NASA felt that it was important to communicate annual progress towards achievement of those goals to make clear the relationship between the current investment and the achievement of longer-term goals. NASA also commented that the fiscal year 2001 plan aggregates a series of individual programmatic outputs to demonstrate trends in activities leading to longer-term goals.

We believe that we have appropriately assessed NASA's performance report and plans in the context of the goals and missions the agency is trying to achieve. Also, we did not conclude, as NASA indicated in its comments, that NASA's revised approach to the Fiscal Year 2001 Performance plan will not provide improved reporting of progress. Our specific concern is that the revised approach allows NASA to assess a performance target as having been met even if some of the performance indicators supporting the target have not been achieved. We maintain that this approach will require NASA to provide convincing evidence that a desired outcome is met despite the nonachievement of one or more of the supporting indicators. Regarding NASA's views on aggregate programmatic outputs, we recognize that some output measures are necessary to show progress or contribution to intended results. However, continued reliance primarily on output measures places added burden on NASA to continuously demonstrate the linkages between program efforts and results and make improvements to strengthen such linkages. Moving toward outcome-oriented measures for important goals and objectives will reduce this burden.

Regarding the credibility of its data, NASA stated that it relies on individuals responsible for the performance to validate and verify the information provided for GPRA compliance and on the NASA Advisory Council to independently evaluate progress. NASA believes we did not acknowledge this independent evaluation by subject matter experts, although we did discuss the Council's remarks in subsequent sections. Our primary point is that NASA's performance report does not provide the reader a perspective of actions NASA is taking to ensure that the information is

accurate and that data limitation issues and problems have been adequately addressed. Communicating verification and validation approaches provides greater confidence that the reported performance information is credible and enhances the usefulness of the information. At the same time, making congressional and other decisionmakers aware of significant data limitations and their implications allows them to properly judge the significance of results achieved. We have revised the report to reflect the Advisory Council's independent evaluation role.

NASA also provided suggestions to improve the technical accuracy of the report. We incorporated those suggestions where appropriate.

NASA's written comments are presented in enclosure III.

As arranged with your office, unless you publicly announce the contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time copies to others will be available on the Internet at <http://www.gao.gov>.

Please call me on (202) 512-4841 if you or your staff have any questions. Key contributors to this report were Richard J. Herley, Shirley B. Johnson, Charles W. Malphurs, John A. Deferrari, and Elizabeth L. Johnston.



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Observations on the National Aeronautics and Space Administration's Fiscal Year 1999 Actual Performance and Fiscal Year 2001 Planned Performance Related to Key Outcomes

This enclosure contains our observations on the National Aeronautics and Space Administration's (NASA) fiscal year 1999 actual performance and fiscal year 2001 planned performance for key outcomes identified by the Senate Governmental Affairs Committee as important mission areas for the agency. The key outcomes for NASA are to (1) expand scientific knowledge of the Earth system; (2) deploy and operate the International Space Station safely and cost-effectively; and (3) expand the commercial development of space. As requested we have identified the goals and measures directly related to a selected key outcome. Our observations are organized according to each selected key outcome and follow the goals and measures.

Key Agency Outcome: Expand Scientific Knowledge of the Earth System

Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

Objective: Understand the causes and consequences of land-cover/land-use change.

Targets:

(1) Begin to refresh the global archive of 30-meter land imagery from Landsat 7, two to three times per year. A single global archive has not been constructed since the late 1970s. Landsat 7 also includes a 15-meter panchromatic band for the study of ecosystems disturbance.

(Target met.)

(2) Begin to collect near-daily global measurements of the terrestrial biosphere (an index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on the Earth Observing System (EOS) Terra AM-1 spacecraft.

(Target not met.)

(3) Collect near-daily global measurements of ocean color (an index of ocean productivity from which calculations of ocean update of carbon are made).

(Target not met.)

Objective: Predict seasonal-to-interannual climate variations.

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Targets:

(4) Begin the second of a 3-year sequence of instantaneous measurements of rainfall rates and monthly accumulations in the global tropics. This will be the first-ever measurement of global tropical rainfall. Current uncertainty in global tropical rainfall estimates is 50 percent. Tropical Rainfall Measuring Mission (TRMM) data will reduce this uncertainty to 10 percent, an 80-percent improvement.

(Target met.)

(5) Begin the measurement of sea-surface wind speed and direction at a spatial resolution of 25-kilometer resolution over at least 90 percent of the ice-free global oceans every 2 days. This represents a resolution increase of a factor of two and a 15-percent increase in coverage over previous measurements. Data from this mission will be used to improve the short-term weather forecasts.

(Target met.)

Objective: Identify natural hazards, processes, and mitigation strategies for floods, droughts, and volcanoes.

(6) Provide instruments sufficient to create the first digital topographic map of 80 percent of the Earth's land surface between 60 degrees north and 56 degrees south. The Shuttle Radar Topography Mission will be ready for launch by the end of fiscal 1999.

(Target met.)

(7) Use the Global Positioning System (GPS) array in southern California to monitor crustal deformation on a daily basis with centimeter precision and initiate the installation of the next 100 stations. The data will be archived at the Jet Propulsion Laboratory (JPL) and run in models, with the results given to the California Seismic Safety Commission and the Federal Emergency Management Agency to be used for earthquake warning.

(Target met.)

(8) Ensure that data received from GPS receivers in low-earth orbit will also be used to test improved algorithms for measuring atmosphere temperature. The data will serve as the future prototype for improving short-term weather forecasts globally. The data will be archived at JPL, and the results will be published in science literature.

(Target not met.)

Objective: Detect long-term climate change, causes, and impacts.

Targets:

(9) Begin to conduct daily observations of cloud properties, such as extent, height, optical thickness, and particle size.

(Target not met.)

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(10) Map aerosol formation, distribution, and sinks over the land and oceans.
(Target not met.)

(11) Achieve significant reduction in the uncertainty in components of the earth's radiation balance (that is, improved angular models leading to an estimated error reduction in regional-scale, monthly- average net radiation of about 50 percent).
(Target not met.)

Objective: Understand the causes of variation in ozone concentrations and distribution in the upper and lower atmosphere.

Targets:

(12) Use new retrieval methods to collect and analyze three new data products, including surface ultraviolet radiation, tropospheric aerosols, and in certain regions tropospheric columns. Together with Solar Backscatter Ultraviolet data, there will now be a continuous 20-year data set for total ozone that will measure the ultimate effectiveness of the Montreal Protocol on substances that deplete the ozone layer. These data are also useful in routing aircraft around areas of concentrated volcanic dust. These new and extended data products will be made available on the Total Ozone Mapping Spectrometer Web site for dissemination and access to a broader community than just NASA-sponsored scientists.

(Target met.)

(13) Improve the collection and analysis of measurements provided by the Stratospheric Aerosol and Gas Experiment (SAGE II). These improvements include lunar occultation capability, allowing for new nitrogen trioxide and chlorine dioxide measurements; additional wavelength sampling, providing direct measurements and ability to retrieve aerosols throughout the troposphere; and appreciably higher spectral resolution, allowing significantly improved distributions of water vapor and ozone in the upper troposphere and lower stratosphere. This represents approximately a two-thirds reduction in error in near-tropopause water vapor measurements as well as extension of ozone measurements into the midtroposphere with 10- to 15-percent errors. Such data were not available before.

(Target not met.)

(14) Initiate the full Southern Hemisphere Additional Ozonesonde network to obtain the first-ever climatology of the upper troposphere ozone in the tropics.

(Target met.)

(15) Continue the detailed multi-aircraft study of troposphere chemistry over the tropical Pacific Ocean, especially the contribution of long-range transport of air from South America and Africa to otherwise unpolluted areas. Complete the field measurements phase of the Pacific Exploratory Mission (PEM)-Tropics B (rainy season) with an improved payload that has resulted from an initiative to develop a smaller, lighter payload with equal or better performance than PEM-Tropics-A (dry season). The results will be fully analyzed and published.

(Target not met.)

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(16) Measure surface levels of chlorine- and bromine-containing chemical compounds addressed under the Montreal Protocol to document the decreasing concentrations of the regulated compounds and the rising concentrations of their replacements to quantify the decrease in total halogen abundance in the lower atmosphere. The data will be provided to researchers supporting the World Meteorological Organization assessment process.

(Target met.)

Objective: Successfully launch spacecraft.

(17) Successfully launch three spacecraft, within 10 percent of budget on average.

(Target not met.)

GAO Observations on NASA's Fiscal Year 1999 Actual Performance for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

The associated performance objectives and targets adequately indicate overall progress toward the related outcome and are generally objective and measurable. However, for the most part, the performance targets appear to be output measures. NASA notes in its fiscal year 1999 performance report that it has difficulty in quantifying outcomes and relating current outcomes to current fiscal expenditures because of the long-term character of its objectives. NASA's use of output measures places the burden on NASA to ensure that it continuously links program targets and projected outcomes and makes the improvements needed to strengthen such linkages. The performance information clearly articulates the degree to which the annual targets have been achieved and are directly relevant to the associated performance targets. However, some of the target descriptions should be more concise. While we recognize that scientific phenomena are highly technical in nature, greater attention should be paid to explaining targets and outcomes in "plain English." The performance report includes all performance targets established in the fiscal year 1999 performance plan for this outcome; no targets were excluded or revised. NASA met slightly less than half of its targets for this key outcome. Only one objective, "Predict seasonal-to-interannual climate variations," had been fully met. For one objective, none of its targets were met. The other objectives had a mix of met and unmet targets.

The performance report includes an independent evaluation completed in February 2000 by the NASA Advisory Council. According to the performance report, the Council provided a qualitative evaluation of NASA's fiscal year 1999 performance, going beyond the question of whether NASA met specific performance targets in the fiscal year 1999 performance plan. The Council indicated that the objectives related to this outcome were achieved and highlighted performance targets 1 and 5 as key targets met during fiscal year 1999.

Discussion of data credibility is limited to stating that each of the program and project managers are fully accountable for the accuracy of the performance information. NASA's statement does not provide reasonable assurance that the

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performance information is credible. Our observation, applicable to all key outcomes we reviewed, is that the report would be more useful to decisionmakers if NASA, at a minimum, described procedures used to verify and validate performance information and addressed data limitation problems and issues in its performance data.

Discussion of the verification and validation of supporting data, as well as limitations to that data, would be useful in fully understanding the agency's progress. Over the past several years, we have identified NASA's failure to include explicit procedures it would use to verify and validate performance and address possible data limitations in its annual performance plans. A recent NASA Office of Inspector General (OIG) report also found weaknesses in the accuracy and reliability of fiscal year 1999 performance targets (145) in NASA's performance report.² The OIG found that 5 (22 percent) of the 23 performance targets (unrelated to this outcome) it reviewed were not fully reliable because the supporting data did not accurately support the results described. From the audit results, the OIG concluded that other targets may also have inaccurate supporting data and reported results. A NASA official said that NASA had corrected or clarified specific performance results in the fiscal year 1999 performance report to address the OIG's concerns.

Unmet Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

- (2) Begin to collect near-daily global measurements of the terrestrial biosphere (an index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on the Earth Observing System Terra AM-1 spacecraft.
- (3) Collect near-daily global measurements of ocean color (an index of ocean productivity from which calculations of ocean update of carbon are made).
- (8) Ensure that data received from GPS receivers in low-earth orbit will also be used to test improved algorithms for measuring atmosphere temperature.
- (9) Begin to conduct daily observations of cloud properties such as extent, height, optical thickness, and particle size.
- (10) Map aerosol formation, distribution, and sinks over the land and oceans.
- (11) Achieve significant reduction in the uncertainty in components of the earth's radiation balance.
- (13) Improve the collection and analysis of measurements provided by the SAGE II.
- (15) Continue the detailed multi-aircraft study of troposphere chemistry over the tropical Pacific Ocean, especially the contribution of long-range transport of air from

² Validating FY 1999 Performance Data To Be Reported Under the Government Performance Results Act (GPRA), (IG-00-020, Mar. 28, 2000).

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South America and Africa to otherwise unpolluted areas. Complete the field measurements phase of the PEM-Tropics B (rainy season) with an improved payload that has resulted from an initiative to develop a smaller, lighter payload with equal or better performance than PEM-Tropics-A (dry season).

(17) Successfully launch three spacecraft, within 10 percent of the budget on average.

GAO Observations on NASA's Unmet Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

The performance assessments indicate that targets 8 and 15 were only partially met. The assessments provide a reasonable explanation as to why target 15 was not fully met but does not provide a clear explanation of the reason target 8 was not fully met. As a result, the impact of not having data from Global Positioning System receivers to test improved algorithms for measuring atmosphere temperature on this key outcome cannot be determined, and corrective actions cannot be assessed at this time. The assessment describes clear and reasonable actions that will be taken to complete target 15. While a reasonable time frame is provided for completion of target 15, no time frame is indicated for completion of target 8.

The performance assessments indicate that targets 2, 3, 9, 10, 11, 13, and 17 were not met. NASA provided reasonable explanations for not achieving these targets and reasonable time frames for achieving them. The nonachievement of these targets was tied to the delay associated with the Terra launch or issues related to SAGE III. Target 17 referred to three launches; one launch was Terra, which was delayed. Achievement of that launch along with the other six targets was deferred to fiscal year 2000. Target 17 was written for Terra to deliver specific performance levels for fiscal year 1999—launch within 10 percent of the budget. NASA had no opportunity to launch Terra within 10 percent of the budget in fiscal year 1999 because the launch was delayed. Therefore, target 17 was determined to be unachievable because opportunity to perform at the specified levels had passed. Terra was later launched, in December 1999, and NASA anticipates that data collections associated with the fiscal year 1999 targets related to this key outcome will be accomplished in fiscal year 2000.

Fiscal Year 2000 Performance Goals and Measures for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

In our view, 21 of the 27 fiscal year 2000 performance targets are new for this outcome. They are as follows:

- Sensor Intercomparison and Merger for Biological and Interdisciplinary Ocean Studies will merge Moderate Resolution Imaging Spectrometer (MODIS) ocean color data into the global ocean color time series, which began with the Ocean Color Temperature Sensor and the Sea-viewing Wide Field-of-view Sensor. Use the time series to understand and predict the response of the marine ecosystem to

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climate change. The data set will be made available via the Goddard Space Flight Center Distributed Active Archive Center.

- Produce near-real-time fire monitoring and impact assessments based on Landsat and EOS inventory and process monitoring. These assessments will provide an observational foundation for monitoring changes in ecosystem productivity and disturbance. Near-real-time assessments will be posted on a Web site for quick access by researchers and regional authorities.
- Establish a benchmark for global and regional rainfall measurements by combining TRMM measurements with measurements from other sources. Maps of the diurnal cycle of precipitation will be created for the first time. The existing 10-year data set will be combined with TRMM measurements to validate climate models and demonstrate the impact of rainfall on short-term weather forecasting. The data will be distributed through the Goddard Space Flight Center Distributed Active Archive Center for ease of access to science and operational users.
- Develop and improve methods to couple state-of-the-art land surface and sea ice models to a global, coupled ocean-atmosphere model and use them to predict regional climatic consequences of El Nino or La Nina in the tropical Pacific. The results of this research will be published in open literature and provided to the National Oceanic and Atmospheric Administration's National Climate Prediction Center and the U.S. Navy's Fleet Numeric Prediction Center. The ultimate goal is to develop a capability to significantly improve the prediction of seasonal-to-interannual climate variations and their regional climate consequences. The main focus is on North America.
- Measure production and radioactive properties of aerosols produced by biomass burning in Africa based on SAFARI 2000 (field experiment) and EOS instruments. This will include extensive international participation. This burning is estimated to contribute one half of all global atmospheric aerosols.
- Launch the NASA-Centre Nationale d'Etudes Spatiales (CNES) Jason-1 mission. This follow-on to the Ocean Topography Experiment/Poseidon is to achieve a factor-of-4 improvement in accuracy in measuring ocean basin-scale, sea-level variability. This is one order of magnitude better than that specified for the Ocean Topography Experiment/Poseidon.
- Generate the first basin-scale, high-resolution estimate of the state of the Pacific Ocean as part of the international Global Ocean Data Assimilation Experiment.
- Use southern California GPS array data to understand the connection between seismic risk and crustal strain leading to earthquakes.
- Develop models to use time-varying gravity observations for the first time in space.

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- Demonstrate the utility of space-borne data for flood-plain mapping with the Federal Emergency Management Agency.
- Develop an automatic volcano cloud/ash detection algorithm employing EOS data sets for use by the Federal Aviation Administration.
- Complete the collection of satellite data needed for the 17-year cloud climatology being developed under the International Satellite Cloud Climatology Project. These data will be used to improve the understanding and modeling of the role of clouds in climate and will be available through the Goddard Distributed Active Archive Center.
- Provide for the continuation of the long-term, precise measurement of the total solar irradiance with the launch of the EOS Active Cavity Radiometer Irradiance Monitor.
- Acquire, through a Radarsat repeat of the Antarctic Mapping Mission conducted in September-October 1997, a second set of high-resolution radar data over all of Antarctica for comparison with the baseline data set acquired in 1997, to identify changes on the ice sheet.
- Publish the first detailed estimates of thickening/thinning rates for all major ice drainage basins of the Greenland ice sheet, derived from repeated airborne laser-altimetry surveys. These measures will represent the baseline data set to compare with early Geoscience Laser Altimeter System data (July 2001 launch).
- Initiate a program of airborne mapping of layers within the Greenland ice sheet to decipher the impact of past climate variations on polar regions.
- Develop a remote-sensing instrument/technique for ocean surface salinity measurements from aircraft. The goal is to improve measurement accuracy to one order of magnitude better than available in fiscal year 1998. The ultimate goal is the capability to measure sea surface salinity globally from space.
- Continue to improve the design and sophistication of a global climate system model, including the use of higher resolution, to make it a state-of-the-art climate system model for projecting the climatic consequences at the regional level. Evidence of improvement will be increased resolution from added computing power and better numerical representations.
- Implement the SAGE III Ozone Loss and Validation Experiment. Measurements will be made from October 1999 to March 2000 in the Arctic/high-latitude region from the NASA DC-8 and ER-2 aircraft and balloon platforms. These tools will help acquire correlative data to validate SAGE III data and assess high-latitude ozone loss.
- Complete the analysis and publication of the PEM-Tropics-B field experiment.

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- Complete the troposphere chemistry aircraft instrument size and weight reductions (by approximately 40 percent) initiative.

In our view, at least 6 of the 27 targets are variations of fiscal year 1999 targets. They are as follows:

- Continue the development of a global land-cover/use change data set based on Landsat and EOS instruments, at a seasonal refresh rate (variation of fiscal year 1999 target 1).
- Continue to collect near-daily global measurements of the terrestrial biosphere (an index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on the EOS AM-1 spacecraft (variation of fiscal year 1999 target 2).
- Continue the ocean color time series with 60-percent global coverage every 4 days—a 35-percent improvement over FY 1999 (variation of fiscal year 1999 target 3).
- Continue the development of the global aerosol climatology data set and analysis of this climatology in climate models. The data will be available through the Goddard Space Flight Center Distributed Active Archive Center (variation of fiscal year 1999 target 10).
- Complete the planning for major new 2001 airborne/unmanned aerospace vehicle missions that will use a smaller troposphere chemistry aircraft instrument (variation of fiscal year 1999 target 15).
- Successfully launch three spacecraft and deliver two instruments for international launches within 10 percent of budget on average (variation of fiscal year 1999 target 17).

GAO Observations on NASA's Fiscal Year 2000 Planned Performance for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

The performance report does not provide an assessment of the effect of fiscal year 1999 performance on estimated performance levels for fiscal year 2000. For example, it does not discuss (1) what goals or measures will be revised to be more outcome oriented, (2) whether NASA will revise the means and strategies section of its fiscal year 2000 performance plan to better show the achievement of specific performance goals, or (3) whether NASA will make changes to its verification and validation practices and procedures in the fiscal year 2000 performance plan to improve the credibility of the agency's performance information.

Of the 27 performance targets for fiscal year 2000, 21 are new. In previous years, NASA officials have stated that performance targets may change from one fiscal year to another because some are discrete events that take place within a fiscal year, some

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change with the phase of a program, and others are expected to be achieved in a specific fiscal year with no carryover to a subsequent fiscal year. Therefore, many of NASA's performance targets are new each fiscal year. We believe this is reasonable if NASA establishes performance measures that cover significant efforts and critical management issues and problems. However, including the rationale for newly established targets in annual performance plans and reports would clarify the reasons for the new targets.

Fiscal Year 2001 Performance Goals and Measures for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

In our view, 8 of the 11 fiscal year 2001 performance targets are new for this outcome. They are as follows:

- Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting at least three multiyear data set. An example of this will be development of a global time series of phytoplankton biomass and primary productivity in the oceans.
- Explain the dynamics of the global carbon cycle by building improved models and prediction capabilities. One indicator of this activity is improving ecological models needed to predict ecosystem responses to global environmental changes by 15 percent.
- Explore the dynamics of global water cycle by developing, analyzing, and documenting at least one multiyear data set such as that needed to obtain accurate maps of the sunrise to sunset changes in precipitation.
- Explain the dynamics of the global water cycle by building improved models and prediction capabilities, specifically improving current understanding of the large-scale effects of clouds on climate.
- Explain the dynamics of long-term climate variability by building improved models and prediction capabilities. One example of this activity will be demonstrating experimental seasonal climate predictions by using next generation super computing systems and new-coupled air-ocean-ice models.
- Explore the dynamics of atmospheric composition by developing, analyzing, and documenting at least three multiyear data sets, such as providing continuity of multidecadal total ozone concentration measurements.
- Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities. One example of this activity will be characterizing the atmospheric plume flowing out of East Asia, its evolution as it transits eastward over the Pacific, and its contribution to global atmospheric chemical composition.

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- Explore the dynamics of the earth's interior crust by developing, analyzing, and documenting at least one multiyear data set, such as analysis of 30-meter topographic data for global geological and geomorphic process studies and improved mapping of terrain features.

In our view, at least 3 of the 11 targets are variations of fiscal year 1999 and/or 2000 performance targets. They are as follows:

- The Earth Science Enterprise will successfully develop, have ready for launch, and operate instruments on at least two spacecraft within 10 percent of their schedules and budget to enable earth science research and applications goals and objectives (variation of fiscal year 1999 target 17 and related fiscal year 2000 target "successfully launch spacecraft and deliver 2 instruments for international launches within 10 percent of budget on average").
- Explore the dynamics of long-term climate variability by developing, analyzing, and documenting at least two multiyear data sets. An example is continuing the high-precision, multidecadal record of total solar irradiance, providing a quantitative understanding of the solar forcing effects on the earth's climate (variation of fiscal year 2000 target "Provide for the continuation of the long-term, precise measurement of the total solar irradiance with the launch of EOS ACRIM").
- Explain the dynamics of the earth's interior and crust by building improved models and prediction capabilities. An indicator of this activity will be providing a basis for future tectonic modeling and earthquake vulnerability assessment through completion of the southern California integrated GPS network. (variation of fiscal year 2000 target "Use southern California GPS array data to understand the connection between seismic risk and crustal strain leading to earthquakes")

GAO Observations on NASA's Fiscal Year 2001 Planned Performance for the Key Agency Outcome to Expand Scientific Knowledge of the Earth System

NASA revised its approach to the development of performance targets in the fiscal year 2001 performance plan. What are now known as indicators were considered performance targets in the fiscal years 1999 and 2000 performance plans. The targets are now written more generally, and one or more indicators may support a particular performance target. For example, the fiscal year 2001 target to "explore the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets" has three performance indicators. One of the three indicators provides for the use of Jason-1 satellite data to continue the measurement of ocean basin-scale, sea-level variability and reducing errors to less than 3 centimeters. The indicators in the fiscal year 2001 performance plan are further defined in an appendix to the plan. The performance plan states that (1) the targets have been developed to enable a better understanding of how the specific measures of output (indicators) contribute to the eventual outcomes that are the result of a number of years of research, development, and data analysis and (2) the targets enable NASA to

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display indicators from multiple years, which will contribute to the achievement of the summary targets. This is a significant change. A NASA official said that nonattainment of one of several indicators will not disqualify NASA from claiming achievement—a response to NASA's experience with the fiscal year 1999 performance report, in which targets had to be characterized as unmet when any associated measure was not attained. We believe that this approach will require NASA to provide convincing evidence that a desired outcome was met despite the nonachievement of one or more of the supporting indicators.

Key weaknesses that we identified in NASA's fiscal year 1999 and 2000 performance plans related to this outcome were that the plans did not provide a clear rationale for how information technology (IT)-related strategies and programs contribute to achievement of performance goals and did not discuss procedures for verifying and validating performance data.

In general, NASA's fiscal year 2001 performance plan still does not provide a clear rationale for how IT-related strategies and programs will contribute to achievement of NASA's goals or show any allocation of IT-related dollars and personnel to performance goals. Goals for managing information technology across the agency are stated in terms of broad categories for improvement, such as increased capability and efficiency and enhanced security, but do not include any quantitative measures. The one exception is the goal of increasing dissemination of earth science data, which is accomplished through the EOS Data and Information System. This goal was not included in our assessment of this key outcome. The plan sets several specific goals for increasing the volume and distribution of earth science data and products.

NASA's fiscal year 2001 performance plan still lacks an explicit discussion of procedures that will be used to verify and validate performance data and does not address possible data limitation issues and problems.

Regarding the eight new fiscal year 2001 performance targets, our observations are the same as for the new fiscal year 2000 targets. We also note that NASA's fiscal year 2001 performance plan still relies heavily on output measures for this key outcome. We believe that the continued use of output measures burdens NASA by requiring it to continuously demonstrate the linkages between program efforts and results and to make improvements needed to strengthen such linkages.

Key Agency Outcome: Deploy and Operate the International Space Station Safely and Cost-effectively

Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

Objective: Deploy and operate the International Space Station for research, engineering, and exploration activities.

Targets:

- (1) Deploy and activate the Russian-built Functional Cargo Block as the early propulsion and cargo module.
(Target met.)
- (2) Deploy and activate the first U.S. built element, Unity (Node 1), to provide docking locations and attach ports.
(Target met.)
- (3) Initiate full-scale Multi-Element Integration Testing (MEIT) for elements in the first four launch packages.
(Target met.)
- (4) Deliver the U.S. laboratory module to the launch site in preparation for MEIT.
(Target met.)
- (5) Conduct the physical integration of the Z1 Truss launch package and initiate MEIT.
(Target met.)
- (6) Initiate preparations for the launch of the first Expedite the Processing of Experiments to Space Station (EXPRESS) rack with five payloads on flight 7A.1.
(Target met.)
- (7) Initiate preparations for the launch of the first rack of the Human Research Facility and the Window Observation Research Facility (WORF-1) on the first utilization flight.
(Target not met.)

GAO Observations on NASA's Fiscal Year 1999 Actual Performance for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

NASA's fiscal year 1999 performance plan and report do not include performance objectives and targets that specifically address the key agency outcome of deploying and operating the International Space Station (ISS) safely and cost-effectively.

However, they do include a related objective of deploying and operating the space station for research, engineering, and exploration activities. Our assessment is based

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on that related objective. The associated performance targets adequately indicate overall progress toward the related objective and are generally objective and measurable. However, all of the performance targets appear to be output measures. (See discussion of the outcome of expanding scientific knowledge of the Earth system for NASA's comments related to outcome measures and our general observation of this issue.) The performance information clearly articulates the degree to which the annual performance targets were achieved and are directly relevant to the associated performance targets. The performance report includes all targets previously established in the fiscal year 1999 performance plan for this related objective; no targets were excluded or revised. NASA met all of its targets except one for this related objective.

The performance report includes an independent evaluation completed in February 2000 by the NASA Advisory Council. The Council identified certain significant NASA efforts that NASA did not include in its performance measurements. The evaluation indicated that space station goals need to include all critical events. One safety-related effort identified by the Council as needing performance measures was the development of a crew return vehicle for the ISS. The Council did not comment on the need for cost-control performance measures for the space station. We concur with the Council on NASA's need for safety-related performance measures for the space station. However, we also believe that NASA should modify the related performance objective and establish targets to clearly include safety, cost-control, and risk mitigation measures.

Discussion of data credibility is limited to stating that each of the program and project managers are fully accountable for the accuracy of the performance information. NASA's statement does not provide reasonable assurance that the performance information is credible. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Unmet Fiscal Year 1999 Performance Goals and Measure for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

(7) Initiate preparations for the launch of the first rack of the Human Research Facility and the Window Observation Research Facility (WORF-1) on the first utilization flight.

GAO Observations on NASA's Unmet Fiscal Year 1999 Performance Goal for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

The performance assessment indicates that target 7 was only partially met. We interpret the remanifested launch as indication that the target was not met due to unanticipated delays, and we view this as a reasonable explanation for nonachievement. The assessment describes clear and reasonable actions that are being taken or will be taken to complete aspects of the target and identifies

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reasonable time frames for completion of specific activities. For example, the assessment states that "while continuing in its early design and development phases, the WORF-1 has been remanifested to launch on Utilization Flight-2. It has completed its system requirements review and preliminary design review. During fiscal year 2000, it will complete the Critical Design Review and initiate manufacturing/assembly. The WORF-1 will be delivered to Kennedy Space Center in mid-2001 to support a launch on Utilization Flight-2, 4 months later than originally planned."

Fiscal Year 2000 Performance Goals and Measures for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

The objective in the fiscal year 2000 plan was revised slightly as "Deploy and operate the ISS to advance scientific, exploration, engineering, and commercial objectives."

In our view, six of the seven fiscal year 2000 performance targets are new for this objective. They are as follows:

- Deploy and activate the U.S. laboratory module to provide a permanent on-orbit capability.
- Deploy and activate the Canadian-built Space Station Remote Manipulator System to provide an ISS-based remote manipulating capability for maintenance and assembly.
- Deploy and activate the airlock to provide an ISS-based extravehicular activity capability.
- Deliver to orbit the first of three Italian-built, multipurpose logistics modules to provide a reusable capability for delivering payload and systems racks to orbit.
- Conduct operations with a three-person human presence on the ISS.
- Complete the production of the first X-38 space flight test article in preparation for a shuttle test flight in 2001.

In our view, at least one of the seven targets is a variation of a fiscal year 1999 target and is described as follows:

- Complete preparations for the initial ISS research capability through the integration of the first rack of the Human Research Facility, five EXPRESS racks with small payload research, and microgravity science glovebox (variation of fiscal year 1999 target 7).

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GAO Observations on NASA's Fiscal Year 2000 Planned Performance for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

The performance report does not provide an assessment of the effect of fiscal year 1999 performance on estimated performance levels for fiscal year 2000. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

As indicated, six performance targets for fiscal year 2000 are new. It is not surprising that performance targets change each fiscal year, since launch events, which are NASA's chosen measures, are by definition unique. However, including the rationale for newly established targets in annual performance plans and reports would clarify the reasons for the new targets.

Fiscal Year 2001 Performance Goals and Measures for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

In our view, all six performance targets for fiscal year 2001 are new for this related objective. The new performance targets are as follows:

- Successfully complete the majority of the planned development schedules and milestones required to support MEIT.
- Successfully complete the majority of ISS-planned on-orbit activities, such as delivery of mass to orbit and enhanced functionality.
- Successfully complete the majority of combined ISS-planned operation schedules and milestones as represented by permanent human on-orbit operations.
- Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities.
- Successfully complete no less than 85 percent of the planned Russian program assurance schedules and milestones required for the development of the propulsion module.
- Successfully complete no less than 75 percent of the planned crew return capability schedules. Fiscal year 2001 indicators will include accomplishment of program schedule milestones for phase 1 development of a crew return vehicle that could provide U.S. crew return capability.

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GAO Observations on NASA's Fiscal Year 2001 Planned Performance for the Key Agency Outcome to Deploy and Operate the International Space Station Safely and Cost-effectively

NASA revised its approach to the development of performance targets in the fiscal year 2001 performance plan. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

A key weakness that we identified in NASA's fiscal year 1999 and 2000 performance plans related to this objective was that the plans did not provide a discussion of procedures for verifying and validating performance data. NASA's fiscal year 2001 plan still lacks an explicit discussion of procedures that will be used to verify and validate performance data and does not address possible data limitation issues and problems. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Regarding the 6 new fiscal year 2001 performance targets, our observations are the same as for the new fiscal year 2000 targets. We also note that NASA's fiscal year 2001 performance plan still relies heavily on output measures for this related objective. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Key Agency Outcome: Expand the Commercial Development of Space

Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to
Expand the Commercial Development of Space

Objective: Promote investments in commercial assets as pathfinders in ISS commercial operations and reduce the cost of Space Shuttle operations through privatization, eventual commercialization, and flying payloads.

Target:

(1) Complete the development of a commercialization plan for the ISS and Space Shuttle in partnership with the research and commercial investment communities and define and recommend policy and legislative changes.

(Target not met.)

Objective: Reduce space communications and operation costs through privatization and eventual commercialization.

Targets:

(2) Reduce space communication operation costs 30 to 35 percent compared to the 1996 budget through a consolidated space communications contract to meet established budget targets.

(Target met.)

(3) Develop options and recommendations to commercialize space communications.
(Target not met.)

Objective: Foster consortia of industry, academia, and government; leverage funding, resources, and expertise to identify and develop space commercial opportunities.

Targets:

(4) Increase non-NASA investment (cash and in kind) in space research from \$35 million in fiscal year 1996 to at least \$50 million in fiscal year 1999, a 40-percent increase.

(Target met.)

(5) Establish a new food technology Commercial Space Center.
(Target met.)

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Objective: Revolutionize space launch capabilities.

Targets:

(6) Continue the X-33 vehicle assembly in preparation for flight-testing.
(Target met.)

(7) Complete vehicle assembly and begin flight-testing of the X-34.
(Target not met.)

GAO Observations on NASA's Fiscal Year 1999 Actual Performance for the Key Agency Outcome to Expand the Commercial Development of Space

The associated performance objectives and targets adequately indicate overall progress toward the related outcome and are generally objective and measurable. However, almost all of the performance targets appear to be output measures. (See discussion of the outcome of expanding scientific knowledge of the Earth system for NASA's comments related to outcome measures and our general observation of this issue.) Some targets include quantifiable, numerical values that permit a comparison to actual performance in a previous year. For example, target 2 proposes reducing space communication operations costs 30 to 35 percent compared to the 1996 budget. Fiscal year 1999 performance results for this target indicate that space communication costs were reduced by 32 percent compared to the fiscal year 1996 budget.

A similar example is target 4, which proposes an increase in non-NASA investment (cash and in kind) in space research from \$35 million in fiscal year 1996 to at least \$50 million in fiscal year 1999. Fiscal year 1999 performance results for this target indicate that total non-NASA cash and in-kind investments totaled \$51.2 million for fiscal 1999 compared to \$35 million in fiscal year 1996. The performance report includes all performance targets previously established in the fiscal year 1999 performance plan for this outcome; no targets were excluded or revised. The performance information clearly articulates the degree to which the annual performance targets were achieved and are directly relevant to the associated performance targets. NASA met over half of its targets for this key outcome. NASA met all of its targets on only one objective: "Foster consortia of industry, academia, and government; leverage funding, resources, and expertise to identify and develop space commercial opportunities." It did not meet one objective's target and met a mix of targets on the other objectives.

The performance report includes an independent evaluation completed in February 2000 by the NASA Advisory Council. The Council commented on one performance target for this outcome, target 6, which is identified as having been achieved. The Council noted that while assembly of the X-33 vehicle was on track near the end of fiscal year 1999, enormous challenges remain.

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In the section of the performance report that relates to targets 1 through 5 of this outcome, discussion of data credibility is limited to stating that each of the program and project managers are fully accountable for the accuracy of the performance information. In the section that relates to targets 6 and 7, additional detail indicates the data was verified by senior officials at the field centers and the NASA Program Management Council during the periodic NASA Enterprise review process. However, the detail provided does not provide reasonable assurance that the performance information is credible. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Unmet Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Expand the Commercial Development of Space

- (1) Complete the development of a commercialization plan for the ISS and the Space Shuttle in partnership with the research and commercial investment communities and define and recommend policy and legislative changes.
- (3) Develop options and recommendations to commercialize space communications.
- (7) Complete vehicle assembly and begin flight-testing of the X-34.

GAO Observations on NASA's Unmet Fiscal Year 1999 Performance Goals and Measures for the Key Agency Outcome to Expand the Commercial Development of Space

The performance assessments indicate that target 1 was partially met and targets 3 and 7 were not met. The assessment for target 1 does not explain why the unmet part of the target that was not met, but it does describe clear and reasonable actions being taken to complete aspects of the target and identifies reasonable time frames for completion of the target. For example, the assessment states that the development of a commercial development plan for the ISS was completed, while the development of a similar plan for the Space Shuttle has been delayed. (The reason for the delay was not provided.) The assessment indicates that George Washington University is assisting NASA with the development of a detailed plan for the Space Shuttle and that completion is now expected in March 2000. The assessment provides a clear and reasonable explanation for why target 7 was not met but does not indicate why target 3 was not met. According to the assessment, target 7 was slowed by hardware delivery problems and the resolution of environmental concerns at the White Sands Test Facility. The assessments for both targets 3 and 7 describe clear and reasonable actions that will be taken to meet the targets and identify reasonable time frames for completing the actions.

Fiscal Year 2000 Performance Goals and Measures for the Key Agency Outcome to Expand the Commercial Development of Space

Fiscal year 2000 objectives 1-3 for this outcome have been substantially revised.

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In comparing the revised fiscal year 2000 objectives to the fiscal year 1999 objectives, it is difficult to determine from the rewording whether the objectives changed in fiscal year 2000. The revised fiscal year 2000 objectives are as follows:

- Facilitate access to space for commercial researchers.
- Foster commercial participation on the ISS.
- Meet strategic space mission operation needs while reducing costs and increasing standardization and interoperability.

In our view, 9 of the 12 fiscal year 2000 targets are new for this outcome. They are as follows:

- Invest 25 percent of the space communications technology budget by fiscal year 2000 in projects that could enable space commercial opportunities, including leveraging through a consortium of industry, academia, and government.
- Foster the establishment of a telemedicine hub in Western Europe. NASA and CNES will develop an international telemedicine program to incorporate and connect existing medical informatics capabilities into a user-friendly commercial electronic telemedicine hub and apply lessons learned to human space flight.
- Utilize at least 30 percent of Space Shuttle and ISS fiscal year 2000 capabilities for commercial investigations, per the U.S. Partner Utilization Plan.
- Promote privatization of Space Shuttle operations and reduce civil service resource requirements for operations by 20 percent (from the fiscal year 1996 full-time equivalent levels) in fiscal year 2000.
- Promote privatization and commercialization of Space Shuttle payload operations through the transition of payload management functions (e.g., payload integration managers and payload officers) by fiscal year 2000.
- Within policy limitations and appropriate waivers, pursue the commercial marketing of Space Shuttle payloads by working to allow the space flight operations contractor to target two reimbursable flights, one in fiscal year 2001 and one in fiscal year 2002.
- Increase the expenditures for commercial services to 10 percent of the total space communications budget by fiscal year 2000.
- Conduct the flight-testing of the X-33 vehicle.
- Complete small payload-focused technologies and select concepts to support potential decisions on the flight demonstration of a reusable first stage.

In our view, at least 3 of the 12 targets are variations of fiscal year 1999 targets. They are as follows:

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- Establish up to two new commercial space centers (variation of fiscal year 1999 target 5).
- Reduce the space communications budget submission for fiscal year 2000 30 to 35 percent from the fiscal year 1996 congressional budget submission (variation of fiscal year 1999 target 2).
- Complete vehicle assembly and begin the flight test of the second X-34 vehicle (variation of fiscal year 1999 target 7).

GAO Observations on NASA's Fiscal Year 2000 Planned Performance for the Key Agency Outcome to Expand the Commercial Development of Space

The performance report does not provide an assessment of the effect of fiscal year 1999 performance on estimated performance levels for fiscal year 2000. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Of the 12 performance targets for fiscal year 2000, 9 are new. In previous years, NASA officials stated that performance targets might change from one fiscal year to another because some are discrete events that take place within a fiscal year, some change with the phase of a program, and others are expected to be achieved in a specific fiscal year with no carryover to a later fiscal year. Therefore, many of NASA's performance targets are new each fiscal year. We believe this is reasonable if NASA establishes performance measures that cover significant efforts and critical management issues and problems. However, including the rationale for newly established targets in annual performance plans and reports would clarify the reasons for the new targets.

Fiscal Year 2001 Performance Goals and Measures for the Key Agency Outcome to Expand the Commercial Development of Space

The fiscal year 2000 objective "Meet strategic space mission operations needs while reducing costs and increasing standardization and interoperability" was revised in fiscal year 2001 as "Meet sustained space operations needs while reducing cost."

The fiscal years 1999 and 2000 objective "Revolutionize space launch capabilities" was removed, and a new objective was established in fiscal year 2001. The new objective is "Reduce the payload cost to low-earth orbit by an order of magnitude from \$10,000 to \$1,000 per pound, within 10 years, and by an additional order of magnitude within 25 years." A performance target was not established for the X-33 vehicle as was in fiscal years 1999 and 2000. The performance plan indicated that a performance indicator for the X-33 could not be identified until the liquid hydrogen tank delamination investigation and program impact assessment were complete.

In our view, four of the five performance targets in the fiscal year 2001 plan are new for this outcome. They are as follows:

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- Establish at least 10 new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Centers and find opportunities for space experiments.
- Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are used by commercial partners to develop commercial products and improve industrial processes.
- Increase the percentage of the space operations budget allocated to acquisition of communication and data services from the commercial sector to 15 percent in fiscal year 2001. The Space Communications Program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.
- Achieve at least 95 percent of planned data delivery from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operation requirements in project service legal agreements.

In our view, at least one of the five targets is a variation of a fiscal year 1999 and 2000 target.

- Complete assembly of the third X-34 test vehicle, demonstrate 75 percent of supporting technology developments, and complete competitive solicitations for expanded second-generation reusable launch vehicle efforts. Indicators for supporting technology development include both flight tests and ground tests (variation of fiscal year 1999 target 7 and a related fiscal year 2000 target to "complete vehicle assembly and begin the flight test of the second X-34 vehicle").

The fiscal year 2001 target proposes to complete assembly of the third X-34 test vehicle but also identifies additional actions that will demonstrate 75 percent of supporting technology developments and complete competitive solicitations for expanded second-generation reusable launch vehicle efforts.

GAO Observations on NASA's Fiscal Year 2001 Planned Performance for the Key Agency Outcome to Expand the Commercial Development of Space

NASA revised its approach to the development of performance targets in the fiscal year 2001 performance plan. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

A key weakness that we identified in NASA's fiscal year 1999 and 2000 performance plans related to this outcome was that the plans did not provide a discussion of procedures for verifying and validating performance data. NASA's fiscal year 2001 plan still lacks an explicit discussion of procedures that will be used to verify and

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validate performance data and does not address possible data limitation issues and problems. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Regarding the four new fiscal year 2001 performance targets, our observations are the same as for the new fiscal year 2000 targets. We also note that NASA's fiscal year 2001 performance plan still relies heavily on output measures for this key outcome. (See discussion of the outcome of expanding scientific knowledge of the Earth system for our general observation of this issue.)

Observations on the National Aeronautics and Space Administration's (NASA) Efforts to Address Its Major Management Challenges

The following table identifies the major management challenges confronting NASA. The first column lists the management challenges identified by our office and NASA's Inspector General (IG). The second column discusses what progress, as discussed in its fiscal year 1999 performance report, NASA made in resolving its major management challenges. The third column discusses the extent to which NASA's fiscal year 2001 performance plan includes performance goals and measures to address the management challenges that we and the NASA IG identified.

Table II.1: Major Management Challenges

Major management challenge	Progress in resolving major management challenge as discussed in the fiscal year 1999 performance report	Applicable goals and measures in the fiscal year 2001 performance plan
We have reported that NASA's contract management is a continuing area of high risk. Implementation of the financial management system and its integration with full cost accounting has been delayed. Until the financial management system is operational, performance assessments relying on cost data may be incomplete. (NASA's OIG reported contract management as a GAO-identified management challenge.)	Report states that NASA is assessing the contractor's ability to carry out implementation of the Integrated Financial Management System. However, since the report was issued, NASA has moved to terminate its contract with KPMG to design and implement an integrated financial management system. Therefore, NASA will not meet its prior performance plan commitments. NASA officials have now segmented implementation of the Integrated Financial Management Project into 14 projects that they believe are implementable. NASA's first priority is to contract for the core financial segment. However,	NASA has a performance target to renew its management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training. One of the target indicators is completing installation of the Budget and Core Accounting Integrated Financial Management System at NASA's remaining field locations. However, NASA made a major change to its approach after issuing the plan. NASA is terminating its contract with KPMG to design the system. According to a NASA official, NASA will not meet its performance plan commitments. However, another target is still

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<p>NASA officials will not decide on a project implementation schedule until its budget is submitted to the Office of Management and Budget (OMB) in September 2000. This effort will require increased management attention to correct problems and keep the projects on schedule. Until the financial management system is operational, performance assessments relying on cost data may be incomplete.</p> <p>We have reported that the ISS Program continues to face cost-control challenges. This entails NASA having to implement risk mitigation activities. (NASA's OIG also reported that the ISS Program continues to experience cost overruns and scheduling delays).</p>	<p>applicable. NASA plans to continue taking advantage of opportunities for improved contract management by maintaining a high proportion of performance-based contracts and significant contractor involvement in NASA programs of small businesses, minority institutions, and minority-and women-owned businesses. NASA's plan provides specific indicators for this target.</p> <p>NASA's performance report does not frontally address issues such as cost control, risk mitigation activities, and contingency planning.</p>	<p>NASA's plan does not directly address this management challenge.</p>	<p>None.</p> <p>Report does not address this management challenge. NASA does not consider this issue a management challenge.</p> <p>In March 1998, we reported that the promise of closer cooperation between NASA and the Department of Defense (DOD) and the development of a national perspective on aerospace test facilities remained largely unfulfilled.</p>
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<p>NASA and DOD (1) had not convened most joint test facility working groups on a regular basis, (2) had competed with each other to test engines for new rockets, and (3) had not prepared a congressionally required joint plan on rocket propulsion test facilities.</p> <p>(NASA's OIG did not include this management challenge on the list given to the agency.)</p>	<p>Plan has a comprehensive list of performance goals, objectives, targets, and indicators for the safety and mission assurance management challenge. NASA's performance plan states NASA will address its target to begin research on the ISS by increasing fundamental knowledge and by addressing critical questions on crew health and safety by conducting 6 to 10 investigations on the Space Station. NASA's plan also has a goal to enable and establish a permanent and productive human presence in the Earth's orbit. One of this goal's objectives is to provide safe and affordable access to space. This objective has the following three performance targets: (1) have in place a shuttle upgrade program that ensures the availability of a safe and reliable shuttle system to support Space Station</p>
<p>Other areas identified by the NASA IG</p> <p>Safety and mission assurance: NASA's OIG has reported that safety and mission assurance has become a serious challenge to NASA. The challenges are ensuring an appropriate level of training for staff that conduct safety reviews and evaluations, maintaining adequate safety reporting systems, ensuring compliance with safety standards and regulations, ensuring product safety and reliability, and developing appropriate safety planning mechanisms.</p>	<p>Report discusses several safety-related targets. Included are (1) new safety technologies for terrestrial airport runways and (2) verification of spacecraft fire safety data through cooperative U.S. Russian Mir experiments. The report states that NASA failed to achieve its performance target of achieving 85 percent on-time, successful launches but the agency did meet the requirements and intent of the strategic objective, which is to fly each mission safely. The report states that Human Exploration and Development of Space (HEDS) programs in biomedical research and countermeasures and advanced human support technology produced important scientific and technology research results to improve the health, safety, and performance of space flight crews. NASA states it partially</p>

<p>achieved its target to characterize the Super-cooled Large Droplets (SLD) icing environment, determine its effects on aircraft performance, and acquire and publish data to improve SLD forecasting confidence. The report states NASA achieved its target to identify the contributing causes, potential solutions using current capabilities, and gaps that require technology solutions for the aviation safety areas of controlled flight into terrain, runway incursion, and loss of control. The report states NASA achieved its target of reducing the number of its lost workdays (from occupational injury or illness) by 5 percent from the FY 1994-96 3-year average.</p> <p>assembly milestones and operations (all safety improvements are planned to be in place by 2005), (2) achieve eight or fewer flight anomalies per mission, and (3) achieve 100% on-orbit mission success. The plan has an objective of ensuring the health, safety, and performance of humans living and working in space. This objective has three performance targets: (1) develop new biomedical and technological capabilities to facilitate living and working in space and return to earth, (2) develop and demonstrate technologies for improved life support systems, and (3) initiate implementation of the bioastronautics initiative (acceleration of research and development of countermeasures to maintain the health of flight crews on long duration missions). The plan also has a crosscutting performance target to improve the health of the NASA workforce. The plan includes an objective to reduce the aircraft accident rate by a factor of 5 within 10 years and by a factor of 10 within 25 years. This objective's performance target is to complete 75% of the conceptual designs for preventing and mitigating accidents and to demonstrate tools for accident analyses and risk assessments. The plan also has a performance target to increase the safety of NASA's infrastructure and</p>

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<p>Year 2000 computer problems (NASA's OIG has deleted this area as a management challenge.)</p>	<p>Report states that NASA achieved its performance target of completing the remediation of mission-critical systems by March 1999, consistent with governmentwide guidance for the year 2000.</p>	<p>Report states that NASA achieved its two performance targets: (1) improving IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 1998 baseline and (2) completing the remediation of mission-critical systems by March 1999, consistent with governmentwide guidance for the year 2000. However, the report provides no specifics to judge the success of the</p>
	<p>None. (No longer applicable for FY 2001.)</p>	<p>Plan has a performance objective to ensure that information technology provides an open and secure exchange of information, is consistent with NASA technical architectures and standards, demonstrates a projected return on investment, reduces risk, and directly contributes to mission success. Also, NASA's plan has a performance target to enhance IT security through a reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all</p>

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	<p>effort to improve IT security program. The report does not indicate that NASA has implemented several of our key recommendations (AIMD-99-47): To ensure that its mission critical systems are protected, NASA needs to (1) develop and implement a management oversight process to monitor and enforce field centers' compliance with agencywide policy, (2) ensure that independent reviews of systems' security controls are performed regularly and that identified vulnerabilities are expeditiously corrected, and (3) require and provide strong methods of user authentication. Furthermore, the report does not indicate that the agency has implemented our recommendation that contracts include provisions for ensuring that contract personnel receive computer security training.</p>	<p>NASA personnel. However, NASA's indicators for this management challenge lack sufficient specificity about how performance targets will be met.</p> <p>Report states that NASA failed to meet its target of completing system validation of the Integrated Financial Management Program and completing system implementation at Marshall and Dryden Centers. The report also states that NASA is reassessing the contractor's ability to carry out implementation. However, NASA is terminating its contract with KPMG to design and implement an integrated financial management system.</p> <p>Waste and abuse as financial management system is integrated: NASA's OIG has reported concerns about waste and abuse as NASA integrates its financial management system. NASA has identified its financial management environment, which comprises decentralized, nonintegrated systems, as a significant area of concern in its FY 1998 Federal Managers Financial Integrity Act report. To remedy this situation, NASA</p> <p>Plan has a performance target to renew NASA's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training. One of this target's indicators is completing installation of the Budget and Core Accounting Integrated Financial Management System at NASA's remaining field locations. However, after the plan was issued, NASA terminated its contract with</p>
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<p>indicated it would implement the integrated financial management system. The OIG continues to have serious concerns about delays in delivery of this product, disputes about the scope of the deliverables, and the costs associated with running parallel systems until the system is fully implemented.</p> <p>Our concern about NASA's contract management includes this issue.</p> <p>(NASA's OIG has now categorized this management challenge as one element of the fiscal management category.)</p>	<p>Therefore, NASA will not meet its performance plan commitments.</p> <p>KPMG to design the system. According to a NASA official, NASA will not meet its performance plan commitments. However, another target is still applicable. NASA plans to continue taking advantage of opportunities for improved contract management by maintaining a high proportion of performance-based contracts and significant contractor involvement in NASA programs of small businesses, minority institutions, and minority- and women-owned businesses. NASA's plan provides specific indicators for this target goal.</p> <p>Report states that the X-33 and X-34 advanced technology demonstrators are a part of NASA's ongoing efforts to pave the way for commercial development of reusable launch vehicles that will dramatically reduce cost and increase the reliability of space transportation. NASA states that progress toward initial flight tests of both vehicles continued during FY 1999 but that both efforts were affected by problems. NASA claims it achieved its performance target to continue the X-33 vehicle assembly in preparation for flight-testing. The report also acknowledges the X-33 hydrogen tank failure in November 1999. NASA did not achieve its performance target to</p> <p>Although we did not identify the X-33 advanced technology demonstrator as a major management challenge, we have reported and testified that the program must overcome key technological</p>
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<p>challenges before the development of launch vehicles. (Space Transportation: Status of the X-33 Reusable Launch Vehicle Program (GAO/NSIAD-99-176, Aug. 11, 1999) and Space Transportation: Progress of the X-33 Reusable Launch Vehicle Program (GAO/T-NSIAD-99-243, Sept. 29, 1999)</p>	<p>complete vehicle assembly and begin flight-testing of the X-34. NASA's report does not contain specific information about how NASA is ensuring that the government's best interests are being served in these joint government- and industry-funded programs. NASA does not explain how it determined how much funding and what data rights to give to its industry partners in the X-33 and X-34 programs. Thus, it is difficult to assess the extent cost-effectiveness was achieved. Furthermore, NASA's report does not state how it will initiate prompt corrective actions to preclude delays in the launch schedule.</p> <p>International agreements: NASA's OIG reported that international agreements are needed to ensure effective and efficient programs. Key considerations include program and project vulnerability to schedule delays and cost overruns that require diplomatic rather than contractual solutions, security controls on technology that impact national security, controls to ensure the quality and timeliness of the goods and services provided, and mechanisms to ensure balance between program needs and national considerations.</p> <p>Although we did not identify this issue</p>	<p>government- and industry-funded programs.</p> <p>The report refers to (1) obtaining valuable data from the solar and heliospheric observatory spacecraft, a joint project of the European Space Agency and NASA, and (2) a cooperative effort with Atmospheric Environmental Services of Canada and the FAA to improve understanding of severe icing hazards and thus enhance aviation safety. The report contains an objective of making major scientific contributions to national and international environmental assessments. Performance targets are associated with making significant contributions to international scientific assessments: (1) results of the effects</p>	<p>NASA's plan identifies a performance target to pursue mutually beneficial cooperative activities in aeronautics and space with other nations. NASA states that it strives to leverage resources with other space agencies to minimize the duplication of efforts worldwide. The report states that to meet this target, NASA will establish and implement letters of agreement and memorandums of understanding for appropriate partnerships with foreign space agencies for cooperative activities. However, NASA's indicators for this management challenge lack sufficient specificity. For example, the plan does not specify with which</p>
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<p>as a major management challenge, in November 1999, we recommended measures to enhance NASA's ability to oversee and implement its export controls of ISS-related technologies. (Export Controls: International Space Station Technology Transfers (GAO/NASIAD-00-14, Nov. 3, 1999)</p>	<p>of measured aircraft emissions on the climate will be provided to the Intergovernmental Panel on Climate Change (IPCC); (2) make significant contributions to the World Meteorological Organization Ozone Assessment, and (3) provide a lead chapter author, global-scale data, and researchers to the IPCC assessment report. NASA claims all three of these targets were achieved. NASA also claims fire safety data were verified through cooperative U.S.-Russian Mir experiments.</p>	<p>foreign space agencies NASA will establish letters of agreement and memoranda of understanding.</p>
	<p>NASA recognizes the Earth Observing System Data and Information System (EOSDIS) as a management challenge. (NASA's OIG now categorizes this management challenge under the category "program and project management.")</p>	<p>Report provides no specific information regarding NASA's progress in overcoming the previously reported problems with fielding EOSDIS. However, NASA reports that it exceeded its overall performance goals for EOSDIS by increasing the volume of data archived, the number of customers served, and the number of data products delivered. Rapid technological advances may help explain these performance gains. For example, NASA states that the large increase in data products delivered can be explained primarily by the growth in World Wide Web delivery mechanisms.</p>
	<p>Report states that NASA achieved its performance target of demonstrating an advanced turbine-engine combustor</p>	<p>Plan includes a performance target of increasing the safety of its infrastructure and workforce with</p>

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Years of operations and research activities have left NASA with major environmental cleanup issues. (NASA's OIG now refers to this challenge as environmental management).	<p>that will achieve up to a 50-percent reduction of oxides of nitrogen emissions based on the 1996 International Civil Aviation Organization standard. NASA's report states that it achieved a target of avoiding a 5-percent increase in physical resource costs through alternative investment strategies in environmental and facilities operations. However, NASA's report does not address two key management actions: (1) ranking and addressing liabilities and (2) developing consistent procedures under NASA policy.</p> <p>facilities safety improvements, reducing environmental hazards, increasing physical security, and enhancing safety awareness among its employees. NASA's indicators for this management challenge lack sufficient specificity. For example, the plan states that NASA will reduce incidents of environmental mishaps or noncompliance from the FY 2000 baseline year by 5%. However, the report does not state how NASA will reduce these incidents by 5%. The plan does include a performance indicator implementing 60% of the identified environmental compliance and restoration projects for reducing and managing the agency's \$1.1 billion future unfunded environmental liability. However, the plan provides no other specific information for this indicator.</p>
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COMMENTS FROM THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001



Mr. Allen Li
Associate Director Defense Acquisitions Issues
United States General Accounting Office
Washington, DC 20548

JUN 16 2000

Dear Mr. Li:

NASA appreciates the opportunity to comment on your draft report on NASA's FY 1999 Performance Report and FY 2001 Performance Plan. NASA has two comments with the report: the conclusion that the revised approach in the FY 2001 Performance Plan will not provide improved reporting of progress and the commentary on data validation and verification.

NASA is concerned that the General Accounting Office has not taken the opportunity to assess NASA's report and plans in the context of the goals and missions that we are striving to achieve. NASA attempted to strike a balance, relating current expenditures (and outputs) to the achievement of longer-term goals and objectives (and outcomes). As you know, in a research and development environment, successes are hard won and often characterized by steps forward, followed by interim setbacks. NASA continues to explore approaches that put both successes and failures into a complete and appropriate context. As Research and Development outcomes are frequently not realized for years or perhaps decades, NASA feels that it is important to communicate annual progress towards achievement of those goals to our stakeholders, so that they might understand the relationship of current investments to the realization of those longer term goals.

In restructuring the FY 2001 Performance Plan, NASA took another step towards demonstrating the relationship of annual outputs to achievement of objectives such as "Improve the reliability of space weather forecasting." Space weather impacts terrestrial communications, human space missions and operations of spacecraft engaged in exploration. In aggregating a series of individual programmatic outputs, NASA intends to enable the demonstration of trends in activities such as the collection and analysis of data, which will ultimately allow prediction of events such as solar flares and radiation bursts. The loss of data from a single operational instrument or spacecraft would diminish the knowledge we are generating, but it would not necessarily render us unable to ultimately meet the objective of improved space weather forecasting. The loss of

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data from multiple instruments, on the other hand, could seriously impact our ability to improve the reliability of space weather forecasting.

Our other major concern is the references to the credibility of our data. Unlike many other Federal Agencies, the collection and statistical analysis of data provided by third parties are not a primary consideration in assessing NASA's credibility and performance. In executing NASA's mission to advance and communicate scientific knowledge, to advance human exploration, and to research, develop, verify and transfer advanced technologies, data from "other reliable sources" are not available to verify or validate reported performance. We rely on the individuals responsible for the performance to validate and verify the information provided to us for Government Performance and Results Act compliance and we also rely on the NASA Advisory Council to independently evaluate our reported progress. Your brief statements on data verification and validation do not acknowledge this independent evaluation by subject matter experts, although you do repeat the NASA Advisory Council's remarks in subsequent sections of the Report.

NASA has no major issue with the balance of the findings. Other minor comments and responses to other suggestions including data validation concerns are provided as an enclosure.

Sincerely,



Daniel R. Mulville
Associate Deputy Administrator

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Data Validation

The addition of detailed statements on data validation for each of the targets would significantly increase the length and technical detail of the Performance Reports, without significantly adding value for most readers.

Internal inconsistencies in tabular comments

Several entries note that NASA did not comment on the impact of FY1999 performance on the FY 2000 performance targets and later notes that the insertion of a substantial number of new targets is appropriate, e.g. 21 of 27 Earth Science targets were "new." With the introduction of the new targets, there was very little to comment on in the FY 1999 report. The report also indicated plans for completion, where appropriate.